



# Asia Science Letter

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## Highlights

Several groups of prominent U.S. scientists visited Asia this winter. Colonel Steven Reznick, the AFOSR Commander and Deputy Director, came to Australia in February, and then visited AOARD on 22 February. He met with the Tri-Service Directors, and presented the Civilian Administrative Person of the Year Award for AFOSR to Ms. Etsuko Hiwatashi.

The Taiwan government is starting a new national nanoscience initiative (investing \$100M per year). An AFOSR delegation led by Dr Agee, Director, Physics and Electronics, including Colonel Reznick, Dr. Carlson, Chief Scientist, and Mr. James Fillerup, International Office, LtCol Nowack, AOARD, and Dr. Liu, HQ AFSPC Space Analysis Center, visited Taiwan in February. They visited universities and national agencies involved in nanoscience.

Ms. Joanne Maurice organized and led a multi-disciplinary, multi-Directorate, government and academic team on a highly successful technology assessment trip for high power microwave technology in Japan (Jan'02). Participants included Professors Kris Kristiansen and Carl Collins of Texas Tech University and the University of Texas at Dallas, respectively. Ms. Maurice also hosted distinguished visitor Dr. Art Guenther in Japan (Nov'01) and Singapore (Nov-Dec'01).

Dr. Darrel Hopper from AFRL/HE visited Korea from 28 January-2 February where he gave an invited paper at the AOARD sponsored Conference - The 2nd International Display Manufacturing Conference (IDMC). He also visited corporate, government and university laboratories looking at a range of display technology research ranging from large flat panel displays to wearable displays.

Dr. Lyons participated in the US-Japan System & Technology Forum (S&TF) co-hosted by the Honorable Pete Aldridge, USD (AT&L) and Mr. Takehiko Shimaguchi, Director General, Bureau of Finance and Equipment, Japan Defense Agency. The status of current cooperative programs and possible areas for future cooperation were discussed. Following the S&TF, Dr. Lyons attended the Pacific Security Assistance/Defense Cooperation in Armaments conference. BG Geehan, USA, the PACOM J4 and Mr. Aldridge both addressed the conference. AOARD and ONR participated in the country-by-country review of ongoing collaborative research activities in Asia.

-Terence Lyons, Director

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# Features

## Taiwan National Initiative on NanoScience and Technology

From 2002 through 2007, Taiwan will be spending nearly US\$500M on nanotechnology in a coordinated effort between academia, national laboratories, and industrial research institutes. A number of academic organizations already have active nanotechnology programs. Several consortia have applied to the National Science Council (NSC) for funding under the initiative. As the NSC functions roughly like the US National Science Foundation, it is providing the overall guidance to the initiative, making sure that all the pieces are well integrated. Roughly \$15M of the initiative money is earmarked for international collaboration. (1)

While the current initiative is in the start-up phase, it builds on a strong base of existing work in Taiwan. Many of the key researchers earned degrees and have worked in the U.S., so there are already existing ties to U.S. projects. In February, an AFOSR delegation led by Dr. Jack Agee, AFOSR Director of Physics and Electronics visited some of the major organizations in this effort. The delegation included Col Steve Reznick, AFOSR Deputy Director, Dr. Herb Carlson, AFOSR Chief Scientist, LtCol Mark Nowack, AOARD, Dr. Joseph Liu, HQ Space Warfare Center, and Mr. Jim Fillerup, AFRL International Office. Visits were made to National Science Council, National Taiwan University, National Central University, National Tsing Hua University, National Chiao Tung University, National Cheng Kung University, Synchrotron Radiation Research Center, National Space Program Office, and the Industrial Technology Research Institute.

The Industrial Technology Research Institute (ITRI) has over 6000 people working on applied technology in support of industry in Taiwan. The Nanotechnology Research Center (NTRC) at ITRI is slated to receive 60% of the Initiative outlay. Of this, roughly 20% will go to technologies within 1-2 years of market introduction. Roughly 60% will go to projects aimed at order-of-magnitude advances in the market in five years. The remainder is slated for longer-term R&D in revolutionary technologies. NTRC boasts a 1300m<sup>2</sup> laboratory, half of which is open for collaborative efforts including company startups and projects with universities. (2)

In addition, Dr. Goretta visited several institutes and writes about his visits in the Materials and Structures section of this newsletter. (Nowack)

1. <http://www.nsc.gov.tw>
2. <http://www.itri.org.tw>

## Materials Design by Simulation

First-principles modeling of materials properties has been actively pursued for decades. Progress has been steady, and at times, spectacular. Many problems in materials science have resisted accurate modeling, while other problems can be reliably modeled. In many cases, simulation capabilities have matured to the point where models are descriptive and predictive. These advances are crucial to development of new materials. The guidance that simulation can provide can identify promising new candidates, dramatically decrease development times, lower development costs, and optimize ultimate performance.

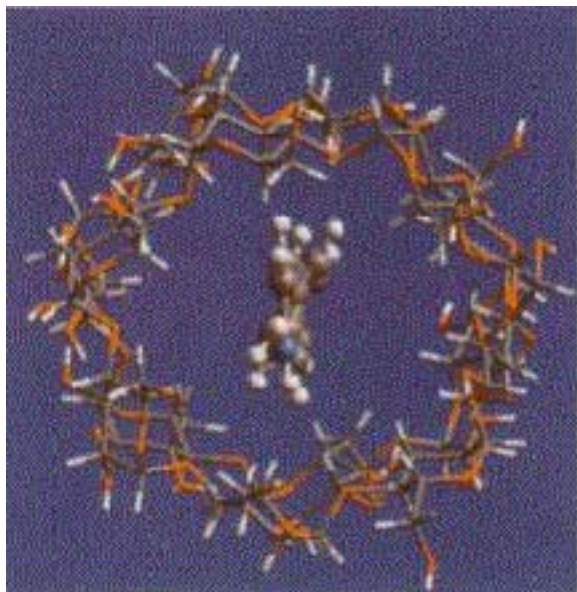
The most obvious and widespread success of simulation of the materials world is probably finite-element modeling (FEM). FEM is now a routine tool for structural and process design. The principal concern with FEM is that it is computing intensive for most users' computer resources. However, its utility is unquestioned. Today, the success of FEM has in many senses been matched, and perhaps surpassed, by simulation of materials structures and properties based on first-principles calculations.

Application of simulation to materials problems, on all scales, has been the theme of the biannual International Conferences on Intelligent Processing and Manufacturing of Materials. The third conference in the series was held on 29 July through 3 August 2001 in Vancouver, British Columbia, Canada (1). That conference featured a special 1.5 day Workshop on "Cyberspace, The Next Frontier in Intelligent Processing and Manufacturing of Materials Modeling, Design & Optimization," which was organized by Dr. Steven LeClair of the AFRL. The fourth conference in the series (IPMM'03) will be held in Sendai, Japan, on 19-23 May 2003. The AFRL and AOARD plan to co-sponsor the conference, which is being co-organized by Prof. Y. Kawazoe of Tohoku University in Sendai and Prof. J. A. Meech of the University of British Columbia, Canada.

Prof. Kawazoe and his staff at the Center for Computational Materials Science (CCMS), which as part of Tohoku University's Institute for Materials Research, address by computer simulation a variety of fundamental materials problems. The CCMS comprises a mix of approximately four dozen staff members, guest researchers, and students. Several ab initio calculation methods are used in their research, with considerable insight and expertise being required to fit the approach to the challenge.

At the heart of the CCMS's facilities is an Hitachi SR8000 supercomputer, installed in April 2001. It supplanted a seven-year-old supercomputer that was capable of 8 Gflops per CPU. The new supercomputer has a total performance of 921 Gflops, which at the time of its installation ranked it 16th in the world. It is unusual for university-based materials researchers to have such vast computing power dedicated to their purposes. Its long-standing use of supercomputers, including gaining access to supercomputers at other institutions in Japan, has fueled the CCMS's research and enhanced its output.

The CCMS's staff chooses which fundamental materials problems to investigate. These problems can be purely theoretical or can be undertaken in support of the experiments of colleagues. Among the problems recently addressed by the Center's staff are structures and electronic properties of clusters and thin films, interactions of carbon fullerenes and nanotubes with various species, formation of silicon-based fullerenes, and phase transformations in geophysical materials. At times, simulation has been used to confirm the validity of an experimental result, such as the recent example concerning the optical properties of fullerene-based polymers. Experimentalists observed what appeared to be an anomalous response based on expectations about whether a specific segment in the chain was an electron donor or acceptor. Simulation confirmed the experimental result and suggested ways in which the chain could be profitably modified.



The simulations completed at the CCMS can help to set the direction of experimental efforts and provide information essential to development of new materials. Recently, such work has included prediction of diodes in carbon nanotubes and formation of silicon fullerenes. Nanotubes diodes have recently been fabricated, as predicted, and several groups are now working on producing silicon fullerenes. Perhaps of most immediate and intense interest is the application possibilities of the CCMS's work with polymeric conductors. Simulations have shown that chain structures can be envisioned

in which a central conducting core is surrounded by a stable insulating sheath. Such conductors offer promise for producing the next generation of computer chips. Current technology for patterning Al or Cu lines faces a practical limitation for spacing of approximately 0.16  $\mu\text{m}$ , and polymer-chain conductors could reduce that limit by two orders of magnitude. The photo included here is a simulated cross-sectional image of a central conducting polymer and its stable insulation sheath.

The capabilities of Tohoku's CCMS are both unique and broadly representative of advances being made in Asia and around the world. The CCMS boasts a combination of computing power and accumulated experience that is indeed rare. It represents, however, only a part of simulation's present and future. When simulation is coupled with well-designed experiments and elegant engineering, the prospects for rapid advances in materials science and applied technology are promising indeed. (Goretta/Park)

1. <http://mining.ubc.ca/ipmm/>

## Computation and Communication

### Super HARP Camera

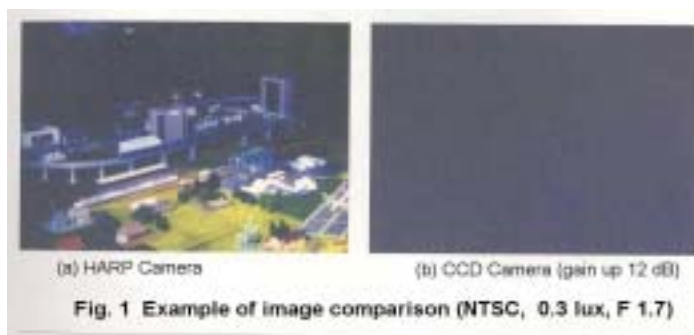
Since 1980, NHK (Nihon Hoso Kyokai; Japan Broadcasting Corp.) has focused their research work on high-sensitivity camera tubes suitable for high definition TV (HDTV). The new Super HARP (High-gain Avalanche Rushing amorphous Photoconductor) film was recently announced as the most promising photoconductor for realizing an ultra high-sensitivity camera. The performance of HARP is based on the avalanche carrier multiplication of amorphous selenium target at high electric field ( $> 10^8$  V/m). The new camera has already been used to shoot very dark scenes where shot noise due to the quantum characteristics of light becomes a serious problem. The Super HARP is the highest sensitivity camera as of the moment. The following four challenging technological issues were addressed:

- 100 % numerical aperture,
- 100 % conversion efficiency,
- low noise signal amplification,
- low lag characteristics.

Major specifications of the new Super HARP camera are as follows:

- Ultra high sensitivity. The camera has a sensitivity of 11 lux / F 8, which corresponds to 600 times of conventional image camera and 100 times of high-sensitivity CCD camera. It can take color pictures of very dark objects imperceptible to the naked human eye. The sensitivity of the camera can be varied over a wide range by changing the voltage applied to the target, and no trouble is encountered during daytime use or under normal lighting conditions. Fig.1 shows a comparison of the characteristics of the HARP camera and a high-sensitivity CCD camera.





- Lag characteristics. The value of lag-image is less than 0.09 % after 50 msec decay-lag time.
- Resolution. The limiting resolution is more than 800 TV lines and can be applied for ultra high-sensitivity High Definition Television (HDTV) image pick up device.
- Noise characteristics. Excess noise figure is low ( $\sim 1$ ) and the ratio of S/N (shot) is about 34 dB for green color.

NHK is turning its research objectives of HARP technology into the following items:

- Super high-sensitivity solid-state HARP TV cameras composed of CMOS image sensor with HARP film.
- Compact imaging device by Spindt field emitter array image sensor with HARP film.

Both will be key devices toward next-generation high-sensitivity compact imaging equipment. Fig. 2 is an example of applications of compact high vision HARP camera. Picture of jellyfish was obtained clearly even at deep-sea of 3000 m.



Fig. 2 Picture at deep-sea by compact high vision HARP camera

For more information, contact Dr. Tanioka of NHK R&D Laboratories (e-mail: [tanioka@strl.nhk.or.jp](mailto:tanioka@strl.nhk.or.jp)). (Miyazaki)

**Symposium: The 10<sup>th</sup> JST International Symposium on Quantum Computing; National Museum of Emerging Science and Innovation, Tokyo; March 12 – 14, 2002**

Among 25 total presentations, 10 were from US scientists, 9 from Asia (mostly Japan) and 6 from EU. Total attendees were about 300.

The seven sessions were included;

- Quantum Computation (4 presentations),
- Physics of Entanglement (3 presentations),
- Cavity QED (2 presentations),
- Ion Trap and NMR (4 presentations),
- Quantum Dot (6 presentations),
- Spintronics (3 presentations),
- Josephson Junction (3 presentations).

As the sub-title of the symposium is [Nano-Science Technology for Implementation of Quantum Computers], the implementation of them is largely relying on materials science and nano-fabrication technology.

In the first two sessions, main topics were on physical principles of quantum computation. In the latter sessions, device physics and technologies for implementing quantum computer were focused from different fields. US and Japan were competing comparably in these fields throughout the world, and NTT laboratories were leading mostly both from theory and experiment.

Among 29 poster presentations, quantum computation and quantum information applied by photonic technologies showed distinct features.

Related conference sponsored by MEXT will be held in Tokyo: [ERATO workshop on Quantum Information Science 2002 (EQIS'02)]; Tokyo, Japan; September 6-8, 2002; (<http://www.qci.jst.go.jp/equis02>). (Miyazaki)

**Conference: The International Conference on Bioinformatics 2002 (InCoB 2002): North-South Networking, Bangkok, Thailand, February 6-8, 2002.**

Bioinformatics or computational biology may be broadly defined as the interface between Life Sciences and Computational Sciences. It is a new science that has been stimulated by recent work on gene sequences such as the Human Genome Project. A crucial component to the recent major advances in genomics research has been the uniting of advances in biology with those in computers, informatics and networking. Bioinformatics apply the latest database techniques and smart mathematical algorithms to gene and protein sequence information in the search for new medical drug leads. The researches in this new field consist of various disciplines such as biologists, computer scientists, physicists and mathematicians.

Bioinformatics is of growing importance to the world as a tool of life science research. It is also important in enhancing the capability of biologists in developing world to competently design experiments and effectively interpret the obtained data so that they can apply their work to solve the problems of the developing countries, which may not attract the interest of scientists in the developed ones.

This Conference consisted of 14 keynote and plenary lectures, 31 oral presentations (in concurrent sessions) and 82 poster presentations. 365 participants from over 20 countries attended this conference. Besides technical sessions, a Mini-

Symposium on North-South Networking was organized on the last day of InCoB 2002 with an objective to create collaboration among scientists from developed and developing countries in bioinformatics for research, infrastructure and human resource development (The resolutions are posted at <http://www.apbionet.org/incob/resolution.shtml>). (Yu, ARO-FE)

**Symposium: Advanced Infrastructure for Information and Communication, Japan Aircraft Hall, Tokyo, Japan, January 30, 2002.**

The Japanese government focuses its R&D funding on four national projects as the important areas where Japan should be considered to be the leading country in the world. Information Technology (IT) is one of the important technologies. In order to realize high-speed, high-reliability and highly sophisticated information and communication systems by 2006, the following core technologies must be developed:

- Fundamental technology of broadband network based on high-speed operation, multifunction and high-reliability (6 themes),
- Information and communication system based on new principles and novel technologies (2 themes),
- Sophisticated technology for implementing high-speed operation and multifunction for wireless network (3 themes),
- Next-generation core software technology (2 themes).

The relevant workshop meeting took up the next five topics among these 13 themes. Total participants exceeded 300. Each session meeting consisted of three invited presentations and one panel discussion.

- Photonic network session meeting. By 2006, a highly advanced switching node would be realized, controlled optically and operated with throughput of over 100 Tb/s and node switch-over time of less than 1 ms.
- Organic devices session meeting. Three main targets were large-scale organic EL display panel (60 inch), flexible film display (0.2 mm thickness) and organic information tag prepared by printing method.
- High power and high frequency device session meeting. GaN active devices were main objectives with specifications of operation frequency of 260 GHz, output power of 20 W and operation frequency of 5 GHz, output power of 200 W.
- Large capacity optical storage technology session meeting. High density read-write technology of 1 Tb / in<sup>2</sup> could be realized by scanning near-field optical microscope (SNOM) technology, hologram memory technology and next-generation super lens optical disk technology.
- Spin memory device session meeting. Magnetic random access memory (MRAM) technology would realize RAM of high density of 100 Gb / in<sup>2</sup> and high speed of several Gb / s until 2006.

Government projects for each topic will be supported for five years under approximate budget of 5 BYen / each. For further details, ask for information to NEDO (New Energy and industries Development Organization) (e-mail: [net-workshop@the-convention.co.jp](mailto:net-workshop@the-convention.co.jp)). (Miyazaki)

**Conference: 1st International Workshop on Quantum Dots for Quantum Computing and Classical Size Effect Circuits (IWQDQC), Kochi, Japan, January 26-28, 2002:**

Recent progress in nanometer structures, especially quantum dots (QDs), and measurements at the nanometer scale will provide the freedom to harness fast and seemingly weak correlations between atoms in an ensemble – correlations that manifest themselves at the macroscopic level. As described by the IWQDQC Chairs, there is no reason why we could not develop novel precision technology from an investigation into quantum computing and fault tolerant computing. Towards this, the Workshop brought together for the first time about 50 researchers in three usually disparate fields – quantum dots, quantum computing, and fault-tolerant circuit design. Their focus was on two applications of QDs: for quantum computers and classical fault-tolerant integrated circuits, which includes hardness to radiation damage. Both of these applications are directly related to information science and technology and also to space missions. The aim was to investigate both the quantum applications and classical applications of quantum dots.

Most contributions were from Europe (especially Germany), Japan, or the US, though there were also contributions from Canada, Israel, China, and Korea. Key national institutes, universities, and corporation labs participated. There was much US Government representation (especially JPL and NRL). Session topics included general quantum computing, semiconductor QD growth and characterization, simulation and theory, coherence in QDs and quantum networks, quantum-computing devices with QDs (photonics, electronics, and spintronics), molecular and other QDs. Highlights:

- Collaborators from the US (U of MI, NRL, and UCSD) reported fundamental progress on QDs as artificial atoms and several first-observations, setting the stage for experimental demonstration of a 2-bit quantum logic gate in a single QD.
- Solid hydrogen as a quantum coherence medium, solid hydrogen being the simplest solid yet with the remarkable feature that H<sub>2</sub> molecules in the solid can freely rotate and vibrate just like in the gas phase (U. of Electro-Communications, CREST, and Japan Science and Technology Corp., Japan)
- Single-wall carbon nanotubes for extremely small (single and coupled) QDs (RIKEN, Japan)
- QDs formed by clusters of spins and the possibility of quantum teleportation (National Institute of Advanced Industrial Science and Technology in Osaka, Japan)
- Quantum optical processes in photonic crystals (photon-photon cross coupling giving rise to entangled 2-photon states, Israel)

IWQDQC was Chaired by Prof. Hideaki Matsueda of Kochi University and Dr. Jonathon P. Dowling of NASA Jet Propulsion Lab (JPL). It was organized by Kochi U. and JPL in cooperation with the Engineering Sciences Society (ESS) and the Institute of Electronics, Information and Communication Engineers (IEICE) in Japan. It was Tri-Service supported. (Maurice)

## Electronics and Physics

**Site Visit: Center for Condensed Matter Sciences and other laboratories, National Taiwan University, Taipei, Taiwan; March 4-5, 2002.**

Taiwan University (NTU) is the largest university in Taiwan (1). Materials research takes place in many departments and centers. The visit centered on the Center for Condensed Matter Sciences. Its focus is on advanced electronic materials and devices. It boasts a first-rate staff and high-quality equipment and facilities. Projects discussed included optical polymers, carbon nanotube research and device development, and wide-band-gap semiconductors. The laboratory of Prof. C.-K. Sun of electrical engineering was also toured. Prof. Sun works on advanced lasers, ultra-fast (fs) phenomena and devices, and new laser-based imaging technology. The laboratories of Profs. R.-S. Liu and T.-I. Ho in the Department of Chemistry were also visited. These professors work on a variety of materials synthesis, processing, characterization, and fundamentals problems. Materials and devices currently being studied include electro-optical polymers, Li batteries, superconductors, CMR materials, biosensors, and organic photochemical compounds. (Goretta)

1. <http://www.eng.ntu.edu.tw/eng/default.htm>

**Site Visit: National Tsing Hua University, Hsinchu, Taiwan, March 1, 2002.**

Similar to its neighboring school in Hsinchu, National Chiao Tung University (NCTU), National Tsing Hua University (NTHU) was founded in China (1). NTHU began, along with the Chinese Republic, in 1911; the Taiwanese university was established in 1956.

The Department of Materials Science and Engineering, which was founded in 1972, is large and diverse. The faculty numbers 30, with current enrollment being 418 undergraduate students, 224 M.S. students, and 113 Ph.D. students. Research programs focus on high-technology electronic materials. In addition to strong and consistent funding from Taiwan's National Science Council, the department has recently received large, multiyear grants from the Ministries of Education and Economic Affairs. A portion of these grants will be used to purchase two state-of-the-art microscopes: an ultra-high-vacuum transmission electron microscope and a dual-ion-beam atomic force microscope. As was described for

NCTU, the close proximity of NTHU to the Hsinchu Science-based Industrial Park and many close relations with various firms located there catalyzes rapid and effective development of new materials and devices. (Goretta)

1. <http://www.nthu.edu.tw/index-e/index.htm>

**USAF High Power PMs and PIs Visit Key National Research Facilities in Japan, January 21 – February 2, 2002:**

A group of High Power AF researchers and recently traveled to Japan for a 2-week tour of Japanese national labs and facilities focused on high power/high energy research. The group consisted of key high-power research managers, PMs and their PIs, including Dr. Jack Agee and Kent Miller of AFOSR/NE, Col Craig Kimberlin of AFRL/PRP, Drs. Jane Lehr, John Gaudet, and Lt Willie McClinton of AFRL/DEHP, Professors Kris Kristiansen and Carl Collins of Texas Tech University and the University of Texas at Dallas, respectively, and additionally, Dr. Terence Lyons and Joanne Maurice of AOARD.

Japan holds considerable expertise in the science and technology of high energy, high power, pulsed power, and plasma physics. Unlike applications in the U.S. however, and aside from those of parallel interest in the energy communities, those in Japan are almost exclusively industrial and commercial, rather than military. In these communities in Japan, novel applications exist in nuclear energy, materials science and processing, and in the environmental, physical, chemical, and medical sciences. For example, fast pulsed current discharge is being implemented to sterilize water, recycle cement, fabricate porous membranes, prepare thin films and ultra fine powders, and to create high-energy-density plasma from powders. Additionally, fast all-solid-state (semiconductor) power devices are being developed for pulsed power applications. These are being employed in particle accelerators, plasma apparatus, and pulsed power generators. In short, the Japanese are combining these technologies to develop advanced techniques that offer diverse options, including those for materials processing and modification.

Our hosts, the facilities toured, their related active research programs and links are:

- Drs. Shuichi Emura and Shuichi Okuda at the Radiation Laboratory at the Institute of Scientific and Industrial Research (ISIR) and the Institute of Laser Engineering (ILE) at Osaka University. The ISIR was founded in 1939 to promote basic science for the development of industry. Its three main research areas currently are interdisciplinary: materials, information, and bioscience. The ILE is pursuing fusion energy using high power lasers via an innovative scheme called "Fast Ignition." (1,2)
- Dr. S. Emura and colleagues at the Japanese Synchrotron Radiation Research Institute (JASRI) "SPring-8," at Hyogo: SPring-8 is an acronym for "Super Photon ring 8 GeV." The facility is one of the world's most advanced for synchrotron radiation, featuring high electron energy,



a long-perimeter storage ring, and high performance insertion devices. It provides high-quality radiation source by increasing the brilliance, expanding the wavelength region of radiation to short wave, shortening pulse width, and improving the directivity and polarization characteristics – all towards dramatically improved accuracy. The beamlines allow realization of unique experiments, as recently demonstrated by Prof. Collins' group (see ASL 33). (3)

- Prof. Shinichi Kobayashi and colleagues in the Departments of Electrical and Electronics Systems and Applied Chemistry at Saitama University, Saitama: Prof. Kobayashi is an expert in vacuum breakdown and its associated physics. He measures secondary electron emission (SEE) of materials under stress towards material choices that overcome avalanche electrical breakdown at the interfaces of the vacuum gap in power transmission systems. Prof. Kobayashi is an IRI award recipient.
- Dr. Yoshio Saito, KEK (High Energy Accelerator Research Organization) and Photon Factory, National Laboratory for High Energy Physics, Tsukuba: Dr. Saito is an expert on windows for the transmission of high-power RF for accelerator applications. He has been working with Prof. Kobayashi (above) in measuring SEE coefficients and surface charging potentials of ceramic dielectrics. They are studying the effect of dielectric permittivity to electrical properties of insulation, especially dielectric strength of material, electroluminescence and flashover when high voltage is applied. Flashover in vacuum is often a limiting factor in many system applications, typically occurring at applied E field strengths much lower than the actual breakdown strengths of materials.
- Prof. Kiyoshi Yatsui and Weihua Jiang, Extreme Energy-Density Institute (EDI), Nagaoka University of Technology, Nagaoka: The EDI is widely known for pulsed power and extreme energy-density engineering technology, which involves simultaneously attaining high temperature, high pressure, and intense magnetic fields. It developed and constructed a series of pulsed-power generators, amongst them the largest in Japan. In addition to high-power microwave generation by coaxial vircator and repetitive pulsed power, the facility provides relativistic pulsed electron beams, has an ion beam accelerator that delivers many species of ions for diagnostics in materials characterization and implantation, and has sublimated solids. Their machines are used mostly for the preparation of a variety of thin films (including hard material), nanosized powders and fullerenes, with the latest generating repetitive pulsed ion-beams for materials processing. The EDI currently has an R&D project with AOARD in its 2<sup>nd</sup> year (related articles in ASL 30 & 32). (4)
- Prof. Kazuo Minami (Niigata U.) and Osamu Ishihara (Yokohama National U.), Niigata University, Niigata: Prof. Minami and Ishihara are doing cutting-edge research in plasma science. They've successfully produced and measured transient cryogenic plasmas in super-fluid liquid helium. The novel nature of the plasma

produced (after pulsed discharges in the He) may involve quantum hydrodynamic phenomena. The lab at Niigata is additionally conducting studies of the interaction of high-power microwaves with plasma -- relativistic electron beams being good sources of high power microwaves and the presence of plasma believed to be an effective means to keep the e-beam quality good. The lab has also designed, fabricated, and tested, a cold cathode gyrotron oscillator and is extending its frequency range to 30 GHz.

- Prof. Shozo Ishii, Tokyo Institute of Technology, Tokyo: Prof. Ishii has organized a Japanese survey of the current status of fast solid-state high power switching devices. Toward devices with fast switching capability, his group is developing improvements on hold-off voltage, switching power loss, rate of current rise, gate-driving techniques. They presented their SI-thyristor as a typical, fast power semiconductor switching device. (5)
- Prof. Hidenori Akiyama, Kumamoto U., Kumamoto: Prof. Akiyama is an internationally recognized figure in his field and most respected in Japan, his classic textbooks continuing into several editions. His large, diverse group hosted the US group for a full day on the last leg of their trip. Prof. Akiyama's group holds claim to especially diverse applications of high power technology that span ecology, biotechnology, and heavy industry – a high power “Carl Sagan.” For example, pulsed power technology is being applied to achieve crop growth (not just improve yields), water purification, deodorization, cleaning of dams and lakes, removal of adhesion organisms, sewer treatment, removal/treatment of the species (NOX and SOX) that cause acid rain, and to dissolve cement. Along more traditional high-energy-density lines, they have a vircator that uses inductive energy storage for pulsed power generation, are researching solid-state opening switches based on a new material, have a 10-ns pulsed power generator, and do work on imploding z-pinch plasmas by exploding wire arrays. (6)

The tour has resulted in follow-on collaborations, in addition to those already pending and online with our hosts. (Maurice)

1. <http://sanken.osaka-u.ac.jp/>
2. <http://www.ile.osaka-u.ac.jp/>
3. <http://www.spring8.or.jp>
4. <http://etigo.nagaokaut.ac.jp/>
5. <http://iyl.ee.titech.ac.jp/>
6. <http://www.eecs.kumamoto-u.ac.jp/eecs/labs/akiyama-lab/akiyama-lab-j.html>

**Window-on-Science Visit: Prof. Kwang-Sup Lee, Department of Polymer Science and Engineering, Hannam University, Taejon, South Korea, December 13-16, 2001.**

Prof. Lee was hosted at the AFRL/ML, Wright-Patterson AFB (WPAFB), by Dr. Paul Fleitz and his colleagues. Prof. Lee presented a seminar entitled “Organics, Polymers, and Organic-Inorganic Hybrids for Photonic Applications.” His work centers on nonlinear optical materials, with emphasis placed on developing materials that are resistant to thermal

relaxation and have enhanced optical properties. He and his colleagues focus on polyurethane as the polymer backbone and have also developed nonlinear optical polyetherimides, polyimides, and organic-inorganic hybrids. Recent efforts include work on the photon-absorption response of several materials, including fluorine and fused-thiophene derivatives. In discussions with researchers at WPAFB, possible collaborations were identified in the areas of synthesis and testing of photon-absorptive materials, development of optical-power-limiting polymers based on dithienothiophene (developed by Prof. Lee and his colleagues) and fluorine, application of specific photon-absorptive materials to lithographic microfabrication, use of various active dyes, and fundamental calculations of absorption coefficients. Following his visit to WPAFB, Prof. Lee presented a paper at the 6th International Conference on Organic Nonlinear Optics, Tucson, AZ, 16-20 December 2001. (1) (Goretta)

1. <http://www.icono6.arizona.edu/>

**Conference: International Symposium on Photonics and Applications (ISPA'01), Singapore, November 27-30, 01.**

The recent ISPA in Singapore consisted of five concurrent conferences: 1) Photonics Materials and Devices, 2) Photonics Systems and Applications, 3) Photonics Sensors, 4) Biophotonics, and 5) Photonics technology in the 21st century. Coverage of the latest developments in photonics technology was showcased in 225 papers and posters representing several 100's of researchers' work. Also included were continuing education programs (several short courses) and a Technical Exhibit.

Besides strong representation from Japan and Singapore, U.S. research was well represented with notable talks by Drs. Waguih Ishak (Agilent Labs), Bob Breault (Arizona Optics Industry Assoc. Inc.), Art Guenther (University of NM and President, International Commission on Optics), and Merek Osinski, (also UNM), and Ronald Hadley (Sandia National Labs). Additionally, AFIT Professor Lt Col James A. Lott presented work on mid-IR quantum dot lasers, while AFRL/DE's Dr. Ron Kaspi presented results on semiconductor mid-IR lasers he fabricated. Colleague Dr. William (Pete) Latham could not attend to give his invited talk on DE's high power semiconductor laser technology program. Agilent Labs' Dr. Ishak, in the kick-off plenary, denounced the communications culprit in the tera-era as the "data glut" rather than lack of bandwidth. He predicts Tbit/s switching times by 2003 and 40 Gbit/s by 2004. Other presenters described electronic wallets, Dick Tracy watches, Pentium-class earrings, input/output hats, and high-resolution eye-glass screens for the future "wearable Internet." It is not surprising that Singapore, already an electronics industry manufacturing leader, actively pursues a role in the development of practical photonics systems. Singapore and Southeast Asia, in general, seek to capitalize on emerging technological innovations in photonics by making products rather than doing basic photonics R&D.

Participation at ISPA'01 was just under 200 – down from the 250+ participants of the previous ISPA'99. This is due in part to the worldwide IT downturn, reflected as a photonics slump, and also to the reluctance of researchers to travel, as evidenced from the number of pulled posters and papers. Overall contributions were notably declined to 225 compared to 350+ in 1999. ISPA'01 was sponsored by SPIE (the International Society for Optical Engineering) and Nanyang Technological University (Singapore) and AOARD-supported. (Maurice and Lott)

**Conference: 7<sup>th</sup> International Conference on Education and Training in Optics and Photonics (ETOP), Singapore, November 26-30, 01.**

Collocated with the ISPA'01 (above) and in conjunction with it, ETOP'01 brought together top educators from all levels and around the world to share their innovative approaches, training methods, and experience relevant to the field of optics and photonics. The 70+ participants represented academia, business, and industry. For the most, a focus was the development of integrated, comprehensive curricula for secondary, post-secondary, and post-graduate levels. But an additional main focus at ETOP was on practical laboratory and technician training. ETOP featured expert coverage of the propagation characteristics of optical fibers, optical devices, and tissues. A multidisciplinary approach is taken on the topic of tissue optics: structural and optical models of tissues with single and multiple scattering -- and ordered and randomly distributed scatterers -- was presented, with noncoherent, coherent, spatially modulated, and polarized light propagation in random and quasi-organized tissues considered. Reflection, transmission, light scattering, and state of polarization of the scattered light by a tissue offers various diagnostic methods. These methods and instrumentation for medical applications were a topic at the ETOP. There were also technical visits to the Temasek Polytechnic, Thales Electro-Optics Pte.Ltd., the Institute for Materials Research (IMRE), and the Photonics Research Laboratories at Nanyang Technological University.

ETOP was Chaired by Prof. Tuan-Kay Lim of Nanyang Technological University (Singapore), and Co-Chaired by Arthur H. Guenther, President of the International Commission for Optics (ICO), Professor at the University of New Mexico, and AFOSR IPA. (Maurice)

**Conference: 3<sup>rd</sup> International Symposium on Advances in Electronics Materials and Packaging (EMAP'01), Jeju Island, Korea, November 19-22, 2001.**

The latest innovations, new findings, emerging technologies, and future R&D prospects in electronics materials, packaging, and assembly were showcased by 80 papers and 130 scholars from ten countries. Topics at the Symposium were: advanced packaging techniques (wafer level, flip chip, CSP, DCA, and multi-chip module), materials and processes (lead-free solders, adhesives, fills, encapsulants, and printed circuit boards), interconnects (wire-bonding, fine-pitch, vias, and build-up



technologies), characterization, testing and measurement (electrical, thermal, mechanical, and chemical), thermal management, packaging for sensors and MEMS, reliability and failure analysis, polymers, ceramics, and metallization.

Leading industry experts from the US, Japan, and Korea provided business perspectives. The first of five keynote speeches was presented by Prof. Michael Pecht, Director of the CALCE Electronic Packaging Research Center at the University of MD, who provided participants with an in-depth survey of electronic reliability engineering and assessment. Prof. Pecht noted key challenges that affect time-delivery of products and are critical to cost-effectiveness and competition. These challenges include such items as the development of failure models for the physics-of-failure (via electromigration, corrosion, and fatigue), and multiple-event and repeated-failure models that address lifetime distributions and repairable systems.

A notable presence at EMAP'01 was Korea's electronic packaging industries. The meeting included a technical exhibit and continuing education program, with several short courses on current packaging trends and technological issues. EMAP'01 was organized by the Korea Advanced Institute of Science and Technology (KAIST), the Computer Aided Reliability Evaluation Packaging National Research Laboratory (CARE), and the Center for Electronic Packaging Materials (CEPM) in collaboration with IEEE. It was ARO-FE and AOARD supported. (Maurice)

**Conference: Optics Japan 2001, November 5-7, 01, Waseda University, Tokyo, Japan.**

Optics Japan 2001 commemorated the 50th anniversary of the Optical Society of Japan (OSJ). Participation in the meeting topped 200 with a large Japanese industrial contingent. Here in Japan, the past five decades of optical science and technology have witnessed accelerated and diversified growth that has spawned entire industries. At present, industries in Japan produce the greater part of products in high-quality optical systems such as cameras (including digital), microscopes and endoscopes, steppers for optical lithography in the microelectronics industry, laser printers, liquid crystal displays, etc.; the US holding the edge in optical design. Far beyond exploiting light for cameras and by physical optics alone, the technological impact of lasers, holography, optical memory and telecommunications was evident at the meeting and represented by speakers from Japan, Europe, the US, Korea, and China. In a 50<sup>th</sup>-year Memorial Lecture, Dr. Arthur H. Guenther, President of the International Commission for Optics (ICO) and Professor at the Center for High Technology Materials (CHTM), University of NM, gave an eloquent assessment of the impact of these technologies on trends in IT, telecommunications, health care and the life sciences, manufacturing, sensing, lighting, energy, and US national defense – each category with its own significant stake in the enabling power of optics. Current R&D efforts in optical science and engineering in Korea and China were reported (Drs. Sang-Yung Shin, KAIST, and Jian-Ling Cao,

Chinese Academy of Sciences). The numbers of research efforts and their funding levels are, however, dwarfed in comparison to counterpart measures in the US and Japan.

Optics Japan was sponsored by the OSJ in conjunction with numerous Japanese academic societies, institutes, and business organizations, and was a mostly-Japanese-language meeting. A recommended website is that of the landmark report prepared by the Committee on Optical Science and Engineering (COSE). This report highlights the impact of optics technology since the 1960's with a forecast for the future and was the topic of Prof. Guenther's talk, "Harnessing Light: Optical Science and Engineering for the 21<sup>st</sup> Century": <http://books.nap.edu/books/0309063922/html/index.html> (Maurice)



Professor Hideo Hosono of the Materials and Structures Laboratory, Tokyo Institute of Technology, receives the Best Paper Award at the Symposium on Optical Materials for High Power Lasers. Prof. Hosono is Director of the JST ERATO project, "Transparent Electro-Active Material." The award was presented to him at the Optics Japan 2001 meeting (above) by colleague Art Guenther, Professor, University of NM, and President, International Commission for Optics (ICO).

**Conference: International Conference on Silicon Carbide and Related Materials (ICSCRM'01), Tsukuba International Congress Center, Tsukuba, Japan, October 28 – November 2, 01.**

The autumn ICSCRM in Tsukuba brought together about 450 researchers of wide bandgap semiconductor materials and devices. Topic coverage spanned crystal growth, characterization, device processing, and device modeling of silicon carbide, Group III-V nitrides, and carbon nanotubes. 20 invited talks focused on different aspects of SiC, nitrides, and related materials and devices. An emphasis at several sessions was on clarification of the obstacles to achieving SiC devices.

There was a special symposium titled "Device and Peripheral technology," along with three rump sessions that posed the questions: "Ion implantation of SiC – A Suitable Technique," "What Affects the Performance of SiC devices," and "A

Roadmap for SiC Technology – SiC Industry in the 21<sup>st</sup> Century.” (Maurice)

**International Conference on Photo-responsive Organics and Polymers 2001 (ICPOP'01), Cheju Island, Korea, August 19-25, 01.** More than 400 researchers participated in the International Conference on Photo-responsive Organics and Polymers 2001 (ICPOP'01) in Korea, far exceeding expectations. Interest in photo responsive/electrical organic molecules and polymers has been growing ever since they've demonstrated promise for high-speed information processing and high-capacity information storage devices. ICPOP presented the state-of-the-art on this tantalizing topic – which couples the electrical and optical properties of metals and semiconductors with the processing and mechanical flexibility advantages of polymers -- in several notable plenary and industrial lectures and two parallel technical and poster sessions.

Chemistry Nobel Laureate Alan Heeger (UCSB), Seizo Miyata (President of Tokyo University of Agriculture and Technology), and Gerhard Wegner (Vice President of Max-Planck Society) Max-Planck Institute) presented plenaries on semiconducting and metallic polymers, polyconjugated macromolecules, and novel electroluminescent devices, respectively. Dongho Kim (Yonsei U., Korea) presented collaborative research with Kyoto University on molecular photonics. This research, based on arrays, extends the concept of a device to the molecular level. A source of inspiration in their nanoscience comes from the light-harvesting antenna complexes of nature's photosynthetic systems. The fused porphyrin arrays provide a much-needed and much-reduced energy bandgap, and thus are an excellent prospect for molecular electronics/photonics. Nanophotonics and its hosts of chemistries were prominent themes in many papers. USAF research on these topics was notable, with well-received invited papers by Charles Lee (AFOSR/NL), Shashi Karna (AFRL/VS), and several of their key principle investigators.

ICPOP'01 was organized by the Japan Society for the Promotion of Science (JSPS), the Korea Science and Engineering Foundation (KOSEF), and Tohoku and Hannam Universities. It was hosted by Prof. Kwang-Sup Lee of the Department of Polymer Science & Engineering at Hannam University and AOARD-supported. For program information and related links: [www.icpop-korea.org](http://www.icpop-korea.org) (Maurice)



Prof. A. Heeger with ICPOP 2001 staff

**Contract awarded: “Japanese and US perspectives on solar terrestrial weather - A cooperative research program between Japanese and US Space Weather Centers,” Prof. Y. Kamide, Solar-Terrestrial Environment Laboratory (STELab), Nagoya University, Aichi Prefecture, Japan.**

In terms of predictability, space weather lags surface (tropospheric) weather by some 50 years or so. In recognition of the need for accurate space weather to support a variety of important commercial applications, the Japanese space physics community established STELab at Nagoya University in 1990. STELab is concerned with space weather from the Sun to our ionosphere. The propagation of heliospheric structures such as coronal mass ejections (CMEs), streamers, co-rotating interaction regions, observation of interplanetary scintillation of natural radio sources are all conducted at STELab on a routine basis.

The mission at STELab is highly complementary to that of the Space Weather Center of Excellence (SWxCoE) established at AFRL/VS, Hanscom, their most obvious difference being the presence of university students at STELab, which swells its staff to over 200! Similar synergies are found in magnetospheric, solar, and other areas. While STELab has established a network of ground-based stations for observation of solar energetic particles of highest-energy, VS has focused on low-energy particle observation from space. While SWxCoE has a strong solar program emphasizing ground-based observation of the Sun's surface and observation of CMEs from space, STELab has a world-leading program in observation and modeling of the solar wind and the magnetospheric-ionosphere system. Indeed, Prof. Kamide commonly figures in on any Japanese NHK (public broadcasting) program on space or the cosmos.

STELab has recently established a computing system called Geospace Environmental Data Analysis System (GEDAS) to promote integrated studies in which ground- and satellite-based observations and simulation research are combined. Under the system, real-time data can be used as initial and boundary conditions for simulations, permitting researchers to forecast important near-future events. GEDAS is not only a data exchange/display system, but a research tool as well. GEDAS will actively be involved in researching and predicting space weather.

Beyond the immediate benefits of synergy and complementarity between two world-premier space weather centers, the new project establishes a closer working relationship between them and offers the advantages of critical mass and joint planning to attack key problems and thereby leverage scarce resources.

This contract is funded by the AFOSR International Research Initiative. POCs: Drs. Edward Cliver, AFRL/VSBS, and Robert Hilmer, AFRL/VS BX (Maurice)

# Human Systems

**Window-on-Science Visit: Prof. Hsiang-Ho Chen, Department of Biomedical Engineering, I-Shou University, Taiwan, Republic of China (ROC), February 25 –March 4, 2002.**

Prof. Chen visited with Col. John Crowley ([John.Crowley@se.amedd.army.mil](mailto:John.Crowley@se.amedd.army.mil)) and the biodynamics team at the US Army Aeromedical Research Laboratory, Ft. Rucker, Alabama, on 25 February. Prof. Chen presented a seminar entitled “Radiographic Determination of Lumbar Lordosis in Helicopter Crews of the R.O.C. Army.” Prof. Chen and his team found significant larger lumbosacral angle and sacral inclination angle in the ROC Army helicopter crews. The most interesting finding is the averaged lumbar lordotic angle of their all-male helicopter crews (34.8°) is closer to the US female average (32.4°) than the male average (28.0°).

Prof. Chen and the Army researchers discussed the hazards of head-supported mass in helicopter crashes, design considerations for helicopter air bags, and human tolerance models for repeated shock in ground vehicles. Prof. Chen then traveled to Ohio and visited with Air Force Research Laboratory’s Drs. Tammy Chelette ([Tamara.Chelette@wpafb.af.mil](mailto:Tamara.Chelette@wpafb.af.mil)), Suzanne Smith ([Suzanne.Smith@wpafb.af.mil](mailto:Suzanne.Smith@wpafb.af.mil)), and Joseph Pelletiere ([Joseph.Pelletiere@wpafb.af.mil](mailto:Joseph.Pelletiere@wpafb.af.mil)).

Prof. Chen presented two seminars at the Wright Patterson AFB. The first one was on “An Electromyographic Assessment of the Anti-G Straining Maneuver” and the other was on “Biomechanical Studies on Spinal Injuries in Fighter Pilots”. In the first study, Prof. Chen and his colleagues applied the electromyography (EMG) to examine the physiological differences of anti-G straining maneuver (AGSM) and found that the trainers were able to hold each of their AGSM respiration cycles significantly longer than the trainees could. Furthermore, EMG data among the respiratory muscles studied revealed that the behavior of cheek muscle could be an excellent indicator for the effectiveness and efficiency of AGSM. In the second study, Prof. Chen noted that spinal compression fractures were the most frequent major injury resulted from ejection by their fighter pilots. In the hope to reduce such injury in the future, his team developed a three-dimensional neck model refined by experimental testing of a dummy with modifiable spinal curvature in an ejection trainer to quantify selection criteria for their candidate pilots. Prof. Chen hopes to promote the occupational safety guideline for their fighter pilots through biomechanical research in conjunction with anthropometrical imaging and human-in-the-loop testing. Prof. Chen and the US biomechanical researchers discussed the possibility of jointly developing an appropriate three-dimensional model of the human spine to optimize crew station design that reduces

spinal injuries. (Crowley-USAARL, Chelette, Smith, and Pelletiere-AFRL/HE). (Crowley & Tsou)

**Research Exposition: Advanced Telecommunications Research Institute International (ATR), Kyoto, Japan, February 14-15, 2002.**

ATR was established in 1986, sponsored by Japan Key Technology Center with funding coming from MITI and the Ministry of Post and Telecommunications. Currently four labs have ongoing research activity:

- Human Information Science Laboratories
- Spoken Language Translation Research Laboratories
- Adaptive Communications Research Laboratories
- Media Information Sciences Laboratories

ATR laboratories have funding and anticipated duration of activity of approximately seven to ten years. Recent reorganization of ATR has included phasing out of research activity at the Media Integration and Communications Laboratory and the Human Information Processing Laboratory, and replacing them with the Human Information Science Laboratories and the Media Information Sciences Laboratories.

The Human Information Science Laboratories studies human information processing and communication. Projects include biomimetics especially in the areas of vision, hearing and speech with the goal of applying these findings to an artificial system.

The Spoken Language Translation Research Laboratory is developing speech dialogue translation technology based on a large corpus of large-scale multi-lingual speech. The goal is speech translation technologies for real world applications. Research also includes speech recognition and spoken language generation for simultaneous translation as well as computer aided language-learning system.

The Adaptive Communications Research Laboratories studies autonomous distributed wireless networks. Projects of interest included smart wireless optical relay modules, adaptive self-organizing networks, routing protocols, omni-directional micro cavity lasers, and the generation & control of complex oscillations in microelectronic devices.

The Media Information Science is a new laboratory begun in October 2001 to create innovative concepts for media in order to achieve new styles of communication. (Lyons)

**Site Visit: SK Corporation R&D Center, Taejon, Korea; February 2, 2002 (POC: Dr. Hong You, Principal Research Scientist).**

Dr. You leads the SAIT project called “O-project TFT,” which stands for organic light emitting diode (OLED) displays with thin-film transistors (TFTs) at the pixels. Dr. You stated that SK has centralized its research in OLEDs at the corporate



R&D center in Taejon in anticipation of a spring 2002 investment of about \$800M to create OLED display manufacturing for cell phones and other mobile electronics. Dr. You indicated that the cell phone market has rejected the use of the near-eye displays in favor of small direct-view displays. Telecommunications products using OLEDs being developed by SK include a third generation (3G) mobile phone, personal digital assistants, and the IBM watch display. SK is a potential participant in a joint US-Korea project consortium on wearable mobile OLED displays to be organized by the Korea Electronics Technology Institute. (Hopper, Lyons)

**Site Visit: Korea Electronics Technology Institute, KyungGi-Do, Korea; February 2, 2002 (POC: President, Dr. Choon-Ho Kim)**

KETI focuses on electronic components and materials and has a budget of \$30-40M for display research; the display research staff comprises 8 full time and 30 visiting scientists. KETI acts as an idea incubator and has spun off a variety of venture companies including Soft Pixel for a plastic liquid crystal display and XMP Display, a joint venture with Russia to build wall display systems based on the tiling plasma panels. KETI was established in 1992 under the Ministry of Information and Communications (MIC) but its funding source has shifted in recent years to the Ministry of Commerce, Industry, and Energy (MOCIE), 70%, and the Ministry of Science and Technology (MOST), 30%, as part of a national cross-agency effort in display technology. (Hopper, Lyons)

**Site Visit: Korean Advanced Institute for Science and Technology, Taejon, Korea; February 1, 2002 (POC: Professor Kwangyun Wohn, Director of the Virtual Reality Research Center at KAIST).**

Areas of discussion included: (a) a personal computer (PC)-based, multi-channel graphic wall display system; (b) a scenario-based wearable computing; and (c) a reality office/command center of the future. Prof. Wohn visited AFRL/HE in April to deliver a Windows on Science lecture to HE and ML researchers. (Hopper, Lyons)

**Site Visit: Samsung Advanced Institute of Technology (SAIT), Suwon, Korea; February 1, 2002 (POC: President, Mr. Wook Sun).**

SAIT has an annual research budget of \$150M. It has just formed a research team in wearable displays. Dr. Sang-Gook Lee, manager of the SAIT Wearable Computer Project described a work in their microelectromechanical systems (MEMS), including a new interface device called "Scurry." Scurry is a new computer interface device that replaces a computer keyboard with gloves with MEMS actuators that detect finger motions as if they were key strokes on a keyboard—one "types" in air. SAIT demonstrated Scurry at a consumer electronics show in late 2001 and plans to introduce it as a product in 2003. (Hopper, Lyons)

**The 2nd International Display Manufacturing Conference (IDMC), Seoul, Korea, January 29-31, 2002.**

About 450 persons from around the world attended IDMC. Topics included Active-matrix LCS, PDP, OLED/ELD/Phosphors, FED and Flat CRT, Emerging Technology, and other topics related with display manufacturing including new display applications, and display business; the proceedings volume totaled 568 pages. Korea is the main producer of flat panel displays. The flat panel display market is now some \$20B and is estimated to grow to \$50B by 2005. Cathode ray tubes are being replaced with flat panel active matrix liquid crystal displays (AMLCDs) at a faster rate than had been anticipated due to two factors: (a) a surge in world wide capacity resulting from the volume strategies being pursued by several Korean and Taiwanese companies, that has caused prices to drop sharply over the last year; and (b) the technology is getting better (9.2 mega pixel display from IBM Japan) and larger (40-in. as demonstrated, 53-in. planned by Samsung).

AMLCDs are now of higher quality than the best CRTs, consume less power (pay for themselves), weigh far less, and take up dramatically less space. Entire buildings are being redesigned based on the dramatic difference between incoming AMLCDs and the outgoing CRTs. The miniature display business is just 1% of the total, and most of it is in presentation projection displays. Miniature displays for head mounted and other near eye applications are just 0.0005% of the commercial market. The speaker from Nokia noted that consumers were not interested in near-eye displays in their cell phones.

On 31 January 2002 Dr. Hopper presented an invited paper entitled "Specialty Application of Flat Panel Displays." In this paper Dr. Hopper developed a business model to transition display research into components, including custom-design units, manufactured in mass market fabrication facilities, like those in Korea, Japan, and Taiwan, for use by niche markets like military, scientific data visualization, business control centers, advertising, and electronic art. Dr. Hopper's paper also addressed the manufacturing challenges to the development of higher resolution visual display systems that the capacity of the human visual system in advanced applications like panoramic cockpits, simulators, and command control centers; the paper has received strong positive comment, both at the conference and in follow up actions. The 3rd IDMC will be held in Taipei, Taiwan in August 2003. (Hopper)

**Site Visit: SK Headquarters Building, Seoul, Korea; January 28, 2002 (POC: Professor Wangyun Wohn) .**

The SK Building houses the highest resolution display in the world: a 72-megapixel (72-Mpx) display system in the SK lobby. New buildings in Korea must spend 1% of their construction budget on art. Thus, in 1999, SK, the leading Korean telecommunications company, commissioned KAIST to design, build, and install a one-of-a-kind piece of electronic

art, namely the 72-Mpx (12,000 x 6,000 pixel) so-called "Parallel Displays for Image and Graphics Manipulation (PARADIGM)" system. PARADIGM processes, renders, and displays interactive high-resolution images based on art. PARADIGM comprises 96 active matrix liquid crystal displays (AMLCDs) driven by a cluster of 27 personal computers (PC). The system is also equipped with two cameras, two modems, and an Internet connection for further interactivity. Software is designed to integrate the camera view of visitors to the SK lobby into the PARADIGM art display. The hardware in PARADIGM cost about \$100K. An improved version of PARADIGM is being developed for installation in the new SK headquarters building now under construction. (Hopper, Lyons)

**Site Visit: Korea Institute of Science and Technology (KIST), Seoul, Korea; January 28, 2002 (POC: Dr. Myungwan Oh, Research Fellow, KIST).**

KIST is working on several display technologies, including organic light emitting diodes (OLED), micro-electro-mechanical (MEM) devices, field-emission cathodes based on carbon nanotubes, and multiperspective 3D. KIST is the first research institute created in Korea (in 1966) and it reports directly to the President of Korea. One key group is lead by Dr. Byeong-Kwon (BK) Ju, Leader of the KIST Display and Nano Devices Lab, and of a KIST venture company called B&P Science, which is commercializing bonding and packaging of silicon on insulator wafers. Dr. Yun-Hi Lee, Principal Research Scientist, KIST Electronic Materials and Devices Research Center is working 3D research with visiting Russian scientists on 4-16 perspective projectors with holographic screens, and holographic overlays for standard 22-in. flat panel active matrix liquid crystal displays with collaboration with a Korean display manufacturer. (Hopper, Lyons)

**Conference: Humanitarian Assistance and Disaster Relief (HADR), Okinawa, Japan, January 22-23, 2002.**

This second meeting, sponsored by Commander, Task Force 76 (CTF-76) focused on the many issues involved in improving the response to humanitarian assistance and disaster relief needs in the Asia-Pacific region. In particular, there was a focus on the exchange of information on the response capabilities of U.S. Naval Forces and those of Japan. The differing resources available and differing response systems were discussed at length. Emerging technologies were presented. Highlights:

- RADM Paul Schultz presented the overview of the HADR mission of Naval Forces and CTF-76, in particular, in the Asia-Pacific region. This was followed by presentations on the role of Commander Naval Forces Japan by Mr. Peter Novik and preparations by the Okinawan Prefectural government by Mr. J. Shirota.
- Mr. Leo Bosner of FEMA discussed his recently published monograph on current Japanese emergency preparedness.

- Dr. Asa Morton presented the concept of Rapidly Deployable Trauma Cells and the importance of building in HADR training into the training of military surgeons.
  - Mr. Richard McSheehy, of the Office of Naval Research, discussed the newly developed modular command center and its application to HADR with a follow-on practical training session.
  - Ms. Nani Marston representing TREXX, Inc. presented recent developments on the rapid assay of biological agents.
- (Marron, Lyons)

**Site Visit: Kyushu Institute of Design, Department of Ergonomics, Fukuoka, Japan (Professor Yutaka Tochiwara).**

The Research Center for Human Environmental Adaptation at Kyushu Institute of Design was completely reconstructed in 2001. The 7 environmental chambers have capabilities including exposure to hypo & hyperbaric, illumination, thermal, water immersion, and thermal radiation. The facility is capable of studying multiple stressors in addition to heat, cold, altitude such as isolation, variation in illumination, etc. The Center includes a living environmental chamber (sleeping facility) for long term exposure; simulation of a window and adjustable outside light was very interesting. Collaborating with Professor Tochiwara is Professor Ohnaka of Fukuoka Women's University. The 10th International Conference on Environmental Ergonomics (ICEE 2002), 23-27 September 2002, will be organized by the Kyushu Institute of Design. (Lyons)



**Site Visit: Toyama Medical and Pharmaceutical University, Toyama, Japan (Professor Minoru Kasuya).**

Toyama Prefecture was the site of the world's first documentation of environmental cadmium poisoning. Slag from a mine polluted the Jinzu River resulting in osteomalacia (metabolic bone disease) in hundreds of local inhabitants. Research in the Department of Public Health has included cadmium toxicity, toxicity prediction, and eco-toxicology. Long term epidemiological studies have been undertaken at

[Toyama Medical and Pharmaceutical University \[38\]](#) by Dr. Keiko Aoshima. (Lyons)

# Material Science and Structures

**Workshop: US – Japan Workshop on Low Cost Production of Ceramics and Related Materials; Hankyu Hotel, Osaka, Japan; March 17 – 20, 2002.**

The special workshop was fully sponsored by ARO-FE, ONR-IFO and AOARD (POC: Dr. D'Andrea of ARO-FE), and organized by Prof. Niihara of Osaka Univ. and Prof. Tresslar of Penn State Univ. Total attendees were about 150, mainly from Japan and US, and partly Asia. In this workshop, the low cost processing and production were mainly discussed to explore the new concept and the future directions by ceramists. The following topics were reviewed and the feasibility for the large-scale products was proposed;

- Powder and related raw materials (5 papers),
- Forming and consolidation for monolithic ceramics (6 papers),
- Forming and consolidation of composites (6 papers),
- Machining, surface finishing and joining (6 papers),
- New materials and processing (6 papers),
- General discussions on low cost production of ceramic materials (2 papers).

Highlights included:

- Production and properties of UBE's SiC long fibers (Dr. Ishikawa, UBE Industries). SiC polycrystalline fiber (SA-Tyranno fiber) was produced from polycarbosilane and exhibited tough thermostructural characteristics of excellent heat-cycle-fatigue and good thermal shock resistance.
- Melt-growth composites for super high temperature applications (Dr. Waku, UBE Industries). Unique ternary melt growth (MGCs) composites were developed with eutectic composition of  $\text{Al}_2\text{O}_3/\text{YAG}/\text{ZrO}_2$ . The present MGCs with a fine microstructure showed an average flexural strength of 800 MPa up to 2000 K.
- Necessary, cost-effective chemical technology to produce ceramics on the large-scale (Dr. Morgan, Rockwell Scientific). Dr. Morgan reviewed all presentations of the workshop. The issues for a dramatic increase in the volume production of high-tech ceramics are related with cost, shape and size. Applications to large scale equipment must be pursued with development of large size technology.

For more information, refer to the following web site (<http://www.sanken.osaka-u.ac.jp/labs/scm/conference>). (Miyazaki)

**Site Visit: National Chiao Tung University, Hsinchu, Taiwan; February 28, 2002.**

National Chiao Tung University (NCTU) has a rich and unique history (<http://www.nctu.edu.tw/english/>). It was founded as Nanyang College, in 1896 in the suburbs of Shanghai, China. Its charter was to promote study of western civilization. Over the years, the college became NCTU and its role as an academic institution broadened significantly. It was disbanded in 1949, but through the efforts of its many alumni and friends, it was resurrected in Hsinchu, Taiwan, in 1957.

The Department of Materials Science and Engineering was founded in 1989. Graduate programs cover the fields of metals, electronic materials, ceramics, polymers, and composites. The department's fourteen faculty members conduct research projects in: Fe-Al-Mn alloys, corrosion, powder metallurgy, semiconductor materials, thin-film technology, interface structures and properties, optoelectronic materials, plasma technology, electronic packaging, micromachining, microstructure characterization, polymeric materials, metal-matrix composites, and fiber-reinforced composites. Owing to programmatic growth, the department will in 2003 occupy facilities in a newly constructed building. The Hsinchu Science-based Industrial Park (see, for example, <http://www.gio.gov.tw/taiwan-website/5-gp/glance/ch11.htm>), which is located near NCTU and National Tsing Hua University, is roughly speaking the Taiwanese equivalent of Silicon Valley. Its close proximity to the two leading Hsinchu universities and the attendant close cooperation among the various entities has led to rapid development of many new electronic technologies. Many of the graduates of NCTU find immediate employment within the Park. (Goretta)

**Site Visit: Mingdao University, Taichung, Taiwan; February 27, 2002.**

Mingdao is a private university that was founded in 2001, when 600 first-year students were admitted (1). The university offers undergraduate degrees in a variety of information- and business-related subjects, applied languages, agriculture, and landscape technologies. Mingdao's Senior Vice President and Provost of Academic Affairs, Dr. Da-Yung Wang, also manages a materials and manufacturing research center that concentrates on surface-modification treatments. Various coatings, including novel doped diamond-like carbon films, are applied to engineering components to improve their resistance to wear and corrosion. Dr. Wang also manages a private firm in Taichung, Surftech, which has commercialized many of the technologies developed by himself and his colleagues. Complex parts can be routinely coated with uniform, robust, resilient coatings. (Goretta)

1. <http://www.mdu.edu.tw>



**Site Visit: Materials Engineering Department, National Chung Hsing University, Taichung, Taiwan; February 26-27, 2002.**

National Chung Hsing University ([http://www.nchu.edu.tw/e-index/index\\_english.htm](http://www.nchu.edu.tw/e-index/index_english.htm)) traces its origins to its founding in Taipei in 1919 as the Advanced Academy of Agronomy and Forestry. It has undergone several significant changes since then, relocating to Taichung in 1943, and assuming its current name in 1971. The Materials Engineering Department began to offer degrees in 1993. It now consists of 10 fulltime professors. Its mission has expanded significantly, and four more professors will be hired soon. Research within the department covers a broad spectrum of technologies. Central themes are surface modification, thin films and coatings, and nanotechnology. The nanotechnology theme will be explored in collaboration with faculty from the Electrical Engineering and Mechanical Engineering Departments. The department houses excellent fabrication and characterization equipment. (Goretta)

**Conference: Third Australian Congress on Applied Mechanics, February 20-22, 2002 Sydney Australia.**

While Australian in name, this AOARD-supported conference was very international in content. This reflects the collaborative nature of Australian research in the area. Session topics included biomechanics; fracture, fatigue and damage; impact and dynamics, smart structures, tribology and manufacturing; and vibration and time-dependent deformation. Paper titles can be found at: <http://www.aeromech.usyd.edu.au/ACAM2002/> (Nowack)

**Site Visit: Department of Materials Science and Engineering, Kyoto, Japan; February 2, 2002.**

Materials research at Kyoto University is conducted within many general and specialized departments, including Materials Science and Engineering, Engineering Physics and Mechanics, Mechanical Engineering, Global Environment Engineering, Electronic Science and Engineering, Material Chemistry, Energy and Hydrocarbon Chemistry, Molecular Engineering, Polymer Chemistry, Chemical Engineering, and Architecture and Architectural Systems (1). The visit was confined to the Science of Metallic Materials Laboratory of Prof. K. Osamura. Current interests of the Laboratory include materials for energy systems, high-strength aluminum alloys, and first-generation high-temperature superconductor wires. Recently developed and patented Al + intermetallic alloys have achieved remarkable strengths of approximately 1 GPa. The superconductor work includes fabrication of wires and tapes, measurement of effects of strain and strain on current transport, and round-robin electro-mechanical testing of commercially available Bi-based tapes. (Goretta)

1. <http://www.kyoto-u.ac.jp/English/>

**Site Visit: Japan Fine Ceramics Center, Nagoya, Japan; February 2, 2002.**

The JFCC is a nonprofit foundation dedicated to testing, inspection, evaluation, and development of fine ceramics (1). It consists of approximately 150 fulltime staff and several dozen members who have been dispatched from other organizations. Foreign collaborations are strongly encouraged, and staff exchanges into and out of the JFCC are common. Research follows 11 themes: nanostructured ceramics, computational design, thin films, information-technology materials, powder processing, sintering, chemical processing, fuel cells, evaluation and International Database Standards, biomaterials, and applications. The JFCC also houses the Frontier Carbon Technology Central Research Department. Approximately 2/3 of the overall budget comes from a government trust. Technological breakthroughs are routinely realized, and several products have been developed. One recent advance is production of multiwalled carbon nanotubes on SiC substrates. Characterization capabilities are excellent and, in some instances, unique. Among the analytical tools that were observed were facilities for electron holography, field-emission-gun transmission electron microscopy of electromagnetic microfields, and hot-stage transmission electron microscopy to 2000°C.

Within the JFCC is also the Superconductivity Research Laboratory (SRL), Nagoya Laboratory, of ISTE (2). The Nagoya Laboratory constitutes a relatively small part of ISTE's SRL. Its mission is to develop cost-effective high-temperature superconductors based on textured coatings on robust substrates. Technologies being pursued include those based on liquid precursors and vapor-phase deposition onto inclined substrates. (Goretta)

1. <http://www.jfcc.or.jp/english/>

2. <http://www.istec.or.jp/>

**Site Visit: National Institute of Advanced Industrial Science and Technology, Nagoya, Japan; February 1, 2002.**

The AIST in Nagoya (<http://www.aist.go.jp/>) comprises numerous Research Centers and Institutes. Staff members, guest researchers, and students work in a broad range of disciplines, which include environmental, medical, information, energy, materials, and manufacturing technologies. Among recently developed products in, for example, environmental applications are photocatalytic titania coatings for air purification, ceramic tiles that control humidity, and rectangular-cross-section logs. The visit centered on the Synergy Materials Research Center (SMRC) and the Ceramics Research Institute (CRI). Efforts within the SMRC focus on development of improved ceramic filters, wear-resistant ceramic components, air-purifying systems that do not require an external power source, and new sensors for use in harsh environments. A team that specializes in developing new or improved property-evaluation and materials-characterization methods buttresses the research and development work. The CRI staff focuses on ecomaterials, mesoporous ceramics, biocompatible nanomaterials, advanced

sintering technologies, and advanced materials sources. To highlight one of many recent advances, new and highly effective liquid precursors have been synthesized for powder production and growth at relatively low temperatures of electronic-ceramic thin films, such as various perovskite and Aurivillius phases. (Goretta)

**Contract awarded: "Constitutive Analysis on High-Temperature Deformation of Ti-6Al-4V Alloy with Transformed Microstructures," Prof. Chong Soo Lee, Pohang University of Science and Technology, Pohang, South Korea, December 2001.**

Titanium alloys have high strength-to-weight ratios and are used in many aircraft and space applications. Ti-6Al-4V alloys exhibit excellent properties, but their complex microstructures have made it difficult to predict effects of hot working on final structures and properties. The work in this project comprises load-relaxation tests in tension and compression of specimens with various specific microstructures; detailed microstructural studies, including quantification of texture; and modeling of effects of deformation on final structures and properties. The models to be developed will enable description of the interaction of plastic flow during hot working and the micromechanisms that control the evolution of microstructure and texture. Such physics-based models are needed to overcome the shortcomings of standard phenomenological approaches, which are incapable of providing accurate descriptions of microstructure and texture, except under the restrictive processing conditions for which they were developed. POC: Dr. Lee Semiatin (AFRL/MLLM). (Goretta)

## Micro Systems

**Workshop: International Workshop on Nano- & Micro-Robotics, Bangkok, Thailand, March 14-15, 2002.**

Researchers gathered in Bangkok to discuss present and future research related to nano- & micro-robotic systems. International representatives from Denso Corporation-Japan, Nagoya University-Japan, the US Air Force Research Laboratory, and the National Research Council (NRC) Canada were present. Representatives from Thailand's National Metal and Materials Technology Center, Ministry of Defense, Chulalongkorn University (CU), and King Mongkut's University of Technology Thonburi participated.

Denso Corporation micro-robotic work has focused on creating 10 mm diameter systems with integrated RF modules (operating at 21.5-22 GHz & 24.125 GHz) providing power and communication information. Work at Nagoya University includes the manipulating, sensing and assembling of nano-systems. The NRC's seventeen institutes and operating budget of 651 million US dollars performs a total of 450 R&D projects a year. Nano-science projects include laser fabrication method development. Methods have been developed to process shape-memory-alloys and piezoelectric

materials. Laser fabrication has been shown to precisely form these materials without affecting the surrounding material properties. Thailand appears to be carefully planning and developing specific critical basic technologies. Nano-technology is one area of expansion. A nano-technology laboratory equipment investment of 1.5 million US dollars was recently made at CU. Scientific directions are tuned to the natural assets of the country (e.g. tropical climate and agriculture focus) and world trends, this has led to work such as solar energy nanosystems. R&D investment often is focused on application-oriented work. The addition and development of micro-sensors for precision machining tools to improve repeatability is an example of basic research supporting commercial applications. Since research is driven by commercial applications, this may result in basic research advances not published since a successful outcome of the effort is based on the commercial reality achieved.

One example presented was the saving of approximately 40 million dollars US in production cost as a result of hard drive head design development. Defense related interests include being a smart technology buyer, adapting to new environments & threats, and improving force projection abilities. Areas of interest include sensors for safety and battlefield sensors. Thailand while having a small basic research investment is highly geared towards developing scientific niches. Nano-technology development in Thailand appears to be high priority area because of potential long-term commercial pay-off and military applications.

**Workshop: 2<sup>nd</sup> workshop of next generation computer science on nano-science and -technology; Sasagawa Memorial Hall, Tokyo, February 14, 2002.**

Research Organization for Information Science & Technology (RIST) is an independent organization under MEXT, and has developed large-scale parallel processing network and system software under collaboration with universities, national institutes and industries. Earth environmental simulators usually consists of super parallel computers which are composed with parallel connections of several thousands of CPU, and conduct large scale computation by Finite Element Method (FEM). These systems can't be easily extended into nano-scale reaction phenomena of atoms or molecules due to large difference of computational scale.

Nano-technology science treats clusters of 1000 to 10 billion objects. As the conventional analytical method of molecular dynamics (MD) can't cope with it, a novel super parallel calculation method is under exploration.

The workshop included 12 lectures and a panel discussion. An invited speaker, Prof. Tomanek (Michigan State Univ., now a visiting professor of Seoul National University in Korea under support by ONR-IFO), showed an example of molecular calculation for carbon nano-tube (CNT). For example, one super workstation took 4 months for its result, and parallel connections of 150 CPUs only 2.5 days. RIST is planning to precede computational science activity with scientists of

various fields in the world. Fig 1 is a diagram of international collaboration for R&D of nanotechnology computer-aided engineering (CAE). RIST (Japan), MSU (US), FhG and NCCR (EU) are core members. The following web page will be established for announcements of their activities; [http://www.tokyo.rist.or.jp/index\\_j.html](http://www.tokyo.rist.or.jp/index_j.html).

### International Collaboration for R&D of Nanotech CAE

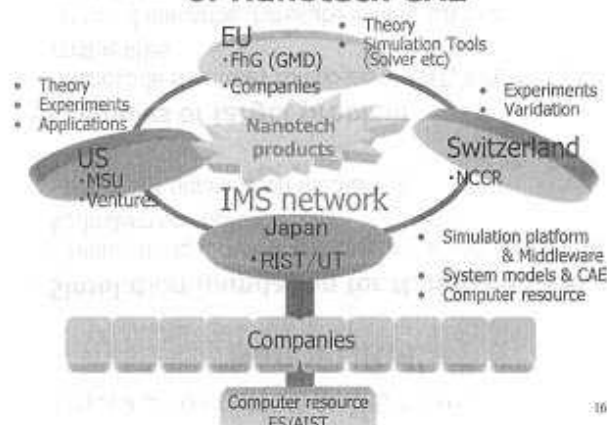


Fig.1 International Collaboration Plan

Since last year many nanotechnology symposia, workshops and seminars have been held in Japan as many as several times every week. The list of conferences participated is

- Nikkei International Symposium on Nanoscience and Nanotechnology; Tokyo; November 16, 2001
- AIST International Symposium on Nanotechnology; Tokyo; November 13 – 14, 2001
- 2001 JRCAT Symposium on Atom Technology; Tokyo; December 11-12, 2001
- 1<sup>st</sup> Symposium on Nanotechnology Material and Structuring Knowledge; Tokyo; December 12, 2001
- Nanotechnology Program on Nanofabrication and Nanoscale Measurement; Tokyo; January 21, 2002
- Forum on Synergy Effect of Specified Material Science; Tokyo; March 11 – 12, 2002

(Miyazaki)

## Upcoming Conferences In Asia

These upcoming conferences may be of interest to you. Contact us for more details or check our homepage at <http://www.nmjc.org/aoard/>. Conferences in **Boldface** are AFOSR/AOARD Supported.

| Date                 | Name   | Place                      |
|----------------------|--|----------------------------|
| May 12-17, 02        | 2002 IEEE World Congress on Computational Intelligence   | Honolulu, HI               |
| May 12-17, 02        | CEC 2002, Congress on Evolutionary Computation   | Honolulu, HI               |
| May 12-17, 02        | IJCNN 2002, International Joint Conference on Neural Networks  | Honolulu, HI               |
| May 12-17, 02        | FUZZ-IEEE 2002, International Conference on Fuzzy Systems  | Honolulu, HI               |
| May 12-17, 02        | 1 <sup>st</sup> International Conference and School on Nanoscale/Molecular Mechanics   | Maui, HI                   |
| May 13-15, 02        | The 35th CIRP International Seminar on Manufacturing Systems (CIRP-ISMS 2002)  | Seoul, Korea               |
| May 13-16, 02        | Fifth Australia/Japan Symposium on Drug Design and Development   | Nara, Japan                |
| May 13-17, 02        | 29th International Conference Imaging Science (ICIS'02)  | Tokyo, Japan               |
| May 14-16, 02        | The 16 <sup>th</sup> International Workshop on Communications Quality & Reliability (CQR 2002)                                       | Okinawa, Japan             |
| May 15-17, 02        | 4th International Symposium on High Performance Computing (ISHPC-IV)   | Kansai Science City, Japan |
| <b>May 15-17, 02</b> | <b>The Seventh World Congress on Biosensors (Biosensors-2002)</b>  | <b>Kyoto, Japan</b>        |
| <b>May 15-17, 02</b> | <b>The 1<sup>st</sup> International Symposium on Energetic Materials and their Applications (ISEM 2002)</b>                          | <b>Tokyo, Japan</b>        |
| May 16-18, 02        | 2002 International CIRP Design Seminar   | Hong Kong, China           |
| May 20-22, 02        | ALTA 2002 Nickel/Cobalt-8  | Perth, Australia           |
| May 20-22, 02        | Parallel CFD 2002, International Conference on Computational Fluid Dynamics  | Kansai Science City, Japan |
| May 21-22, 02        | The 1 <sup>st</sup> International Symposium of Environmentally Compatible Propulsion System for Next-Generation Supersonic Transport | Tokyo, Japan               |
| May 22-24, 02        | International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '02)   | Manila, Philippines        |



| Date                 | Name  | Place                                 |
|----------------------|---|---------------------------------------|
| May 22-24, 02        | The First International Conference on Advanced Structural Steels (ICASS 2002)   | Tsukuba, Japan                        |
| May 22-24, 02        | International Conference Computational Mathematics and Modeling (CMM 2002)  | Bangkok, Thailand                     |
| May 23-24, 02        | ALTA 2002 Copper-7  | Perth, Australia                      |
| May 26-31, 02        | The 12th International Offshore and Polar Engineering Conference (ISOPE-2002)   | Fukuoka, Japan                        |
| May 26-Jun 2, 02     | 23 <sup>rd</sup> International Symposium on Space Technology and Science  | Matsue, Japan                         |
| <b>May 27-31, 02</b> | <b>International Congress on Laser Advanced Materials Processing (LAMP 2002)</b>  | <b>Osaka, Japan</b>                   |
| May 27-31, 02        | The 15 <sup>th</sup> International Conference on Plasma Surface Interactions in Controlled Fusion Devices (PSI-15)          | Gifu, Japan                           |
| May 28-Jun 1, 02     | International Joint Conference on the Applications of Ferroelectrics 2002   | Nara, Japan                           |
| May 29-31, 02        | IFIP WG9.4 Conference on ICTs & Development: New Opportunities, Perspectives, & Challenges                                  | Bangalore, India                      |
| May 30-31, 02        | 19th Sensors, Micromachines, and Application Systems<br>(The official languages of the symposium are Japanese and English)  | Kyoto, Japan                          |
| <b>Jun 2-6, 02</b>   | <b>8<sup>th</sup> International Conference on Functional Mapping of the Human Brain</b>                                     | <b>Sendai, Japan</b>                  |
| Jun 4-6, 02          | 3rd Workshop on Physical Chemistry of Wet Etching of Silicon  | Nara, Japan                           |
| Jun 5-8, 02          | Mechanics & Materials in Design 4 <sup>th</sup> International Conference  | Nagoya, Japan                         |
| <b>Jun 10-11, 02</b> | <b>2<sup>nd</sup> International Workshop on Functional MRI (Principles, Acquisition and Analysis)</b>                       | <b>Daejeon, Korea</b>                 |
| Jun 10-13, 02        | Eighth International Meeting on DNA Based Computers (DNA8)  | Hokkaido, Japan                       |
| Jun 10-14, 02        | The 4 <sup>th</sup> World Congress on Intelligent Control and Automation (WCICA'02)   | Shanghai, China                       |
| Jun 16-19, 02        | 1st International Conference on Control and Automations (ICCA '02)  | Xiamen, China                         |
| Jun 17-18, 02        | International Conference on Artificial Intelligence in Engineering and Technology   | Kota Kinabalu, Malaysia               |
| Jun 19-25, 02        | The 6th International Competitions and Conferences (RoboCup-2002)   | Fukuoka, Japan and<br>Busan, S. Korea |
| <b>Jun 20-21, 02</b> | <b>Nanophysics &amp; Nanotechnology</b>   | <b>Hanoi, Vietnam</b>                 |
| <b>Jun 23-27, 02</b> | <b>Defense Applications for Signal Processing (DASP2002)</b>  | <b>Adelaide, Australia</b>            |
| Jun 25-27, 02        | International Symposium on Distributed Autonomous Robotic Systems (DARS 02)   | Fukuoka, Japan                        |
| Jun 26-28, 02        | The 1 <sup>st</sup> Asian Conference on Photobiology  | Hyogo, Japan                          |
| Jun 27-28, 02        | International Workshop on Femtosecond Technology (FST 2002)   | Tsukuba, Japan                        |
| Jun 29-Jul 5, 02     | International Conference on Science and Technology of Synthetic Metals (ICSM 2002)  | Shanghai, China                       |
| Jun 30-Jul 5, 02     | Second International Conference on Porphyrins and Pthalocyanines (ICPP-2)   | Kyoto, Japan                          |
| Jul 1-5, 02          | The 9 <sup>th</sup> International Symposium on the Genetics of Industrial Microorganisms (GIM-2002)                         | Korea                                 |
| Jul 1-6, 02          | 38th IUPAC Congress -Frontiers in Chemistry, World Chemistry Congress, incorporating 9th Asian Chemistry Congress, AIMECSO1 | Brisbane, Australia                   |
| Jul 2-5, 02          | 8th Asia Pacific Conference of International Astro-Union  | Tokyo, Japan                          |
| Jul 3-5, 02          | FPD Manufacturing Technology Expo (FINETECH JAPAN)  | Tokyo, Japan                          |
| Jul 7-12, 02         | IUPAC World Polymer Congress 2002 - 39 <sup>th</sup> International Symposium on Macromolecules                              | Beijing, China                        |
| Jul 8-12, 02         | 5th Asia Pacific Conference on Control and Measurement  | Lijiang, China                        |
| Jul 8-12, 02         | The 2 <sup>nd</sup> International Conference on Computational Fluid Dynamics  | Sydney, Australia                     |
| Jul 8-12, 02         | 7 <sup>th</sup> OptoElectronics and Communications Conference (OECC 2002)   | Yokohama, Japan                       |
| <b>Jul 8-13, 02</b>  | <b>US-Korea Conference on Science, Technology, and Entrepreneurship-2002 (UKC-2002)</b>                                     | <b>Seoul, Korea</b>                   |
| Jul 9-12, 02         | 2002 Western Pacific Geophysics Meeting   | Wellington, New Zealand               |
| Jul 10-12, 02        | The 9 <sup>th</sup> International Workshop on Active-Matrix Liquid-Crystal Displays   | Tokyo, Japan                          |
| Jul 10-12, 02        | Geometric Modeling and Processing 2002 (GMP 2002)   | Saitama, Japan                        |
| Jul 14-18, 02        | The Fourth International Conference on Matrix Analytic Methods in Stochastic Models   | Adelaide, Australia                   |
| Jul 14-19, 02        | 14 <sup>th</sup> International Conference on Organic Synthesis (ICOS-14)  | Christchurch,<br>New Zealand          |
| Jul 15-17, 02        | 2002 Japan-USA Symposium on Flexible Automation   | Hiroshima, Japan                      |

| Date                 | Name  | Place                  |
|----------------------|---|------------------------|
| Jul 15-19, 02        | The International Congress on Plasma Physics (ICPP 2002)  | Sydney, Australia      |
| Jul 16-19, 02        | The 2002 International Technical Conference on Circuits/Systems, Computers and Communications (ITC-CSCC 2002) | Phuket, Thailand       |
| Jul 16-19, 02        | International Conference on Smart Materials, Structures, and Systems  | Bangalore, India       |
| Jul 16-19, 02        | Inter-Opto '02  | Chiba, Japan           |
| Jul 21-25, 02        | International Conference on Optical Internet (COIN) and Topical Meeting on Photonics in Switching (PS)        | Cheju Island, Korea    |
| Jul 21-26, 02        | Twenty-ninth International Symposium on Combustion  | Sapporo, Japan         |
| Jul 21-26, 02        | 8th International Conference on New Diamond Science and Technology (ICNDST-8)                                 | Melbourne, Australia   |
| Jul 21-26, 02        | World Congress on Particle Technology 4   | Sydney, Australia      |
| Jul 22-24, 02        | Pacific Rim Workshop on Transducers and Micro/Nano Technologies   | Xiamen, China          |
| <b>Jul 22-24, 02</b> | <b>2<sup>nd</sup> Asian Conference on Vision (ACV 2002)</b>   | <b>Gyeongju, Korea</b> |
| Jul 22-25, 02        | World Space Environment Forum (WSEF 2002)   | Adelaide, Australia    |
| Jul 22-26, 02        | 7 <sup>th</sup> International Conference on the Structure of Surfaces   | New Castle, Australia  |
| Aug 4-9, 02          | 14th International Conference on Photochemical Conversion and Storage of Solar Energy (IPS-14)                | Sapporo, Japan         |
| Aug 5-15, 02         | New Directions in Dynamical Systems 2002 (ICM 2002 Satellite Conference)                                      | Kyoto, Japan           |
| Aug 11-14, 02        | International Conference on Micro & Nano Systems (ICMNS 2002)   | Kunming, China         |
| Aug 12-15, 02        | Asia SPM1 & Taipei Symposium on Nanotechnology  | Taipei, Taiwan         |
| Aug 13-18, 02        | 2002 International Conference on Physics and Chemistry of Molecular and Oxide Superconductors                 | Hsinchu, Taiwan        |
| Aug 15-17, 02        | The 8th Annual International on Computing and Combinatorics Conference (COCOON)                               | Singapore              |
| Aug 16-18, 02        | 2nd International Conference on Imaging and Graphics  | Hefei, China           |
| Aug 16-18, 02        | Symposium on Stochastics and Applications (SSA)-An ICM-2002 Satellite Conference                              | Singapore              |
| Aug 16-19, 02        | International Conference on Quantum Transport and Quantum Conference (Localization 2002)                      | Tokyo, Japan           |
| Aug 17-18, 02        | Rescue Robot Contest  | Osaka, Japan           |
| Aug 18-22, 02        | AusBiotech 2002, National Conference  | Melbourne, Australia   |
| Aug 18-22, 02        | Seventh Pacific Rim International Conference on Artificial Intelligence                                       | Tokyo, Japan           |
| Aug 19-23, 02        | The 6th International Conference on Motion and Vibration Control (MOVIC2002)                                  | Saitama, Japan         |
| Aug 20-23, 02        | 11 <sup>th</sup> Seoul International Symposium on the Physics of Semiconductors and Applications              | Cheju, Korea           |
| Aug 20-27, 02        | The 23 <sup>rd</sup> International Conference on Low Temperature Physics                                      | Hiroshima, Japan       |
| Aug 20-28, 02        | ICM-2002 & Satellite Conferences for ICM 2002   | Beijing, China         |
| Aug 21-23, 02        | The 4th Japan-Korea Conference on Ferroelectrics  | Osaka, Japan           |
| Aug 21-23, 02        | The Second International Conference on Advances in Structural Engineering and Mechanics (ASEM'02)             | Pusan, Korea           |
| Aug 22-26, 02        | International Workshop on Photoionization 2002 (IWP2002)  | Hyogo, Japan           |
| Aug 24-27, 02        | International Conference on Experimental and Computational Mechanics in Engineering                           | Dunhuang, China        |
| Aug 26-28, 02        | The Eighth International Symposium on Magnetic Bearings   | Mito, Japan            |
| Aug 26-29, 02        | The 10th International Symposium on Flow Visualization (ISFV10)   | Kyoto, Japan           |
| Aug 27-28, 02        | Asia Pacific Magnetic Recording Conference 2002   | Singapore              |
| Sep 1-6, 02          | The 13th International Conference on Ion Beam Modification of Materials (IBNN2002)                            | Kobe, Japan            |
| Sep 2-4, 02          | The 7th Asian Symposium on Information Display (ASID '02)   | Singapore              |
| Sep 3-6, 02          | Optical Technology and Image Processing for Fluids and Solids Diagnostics                                     | Beijing, China         |
| Sep 3-6, 02          | The IEEE 5th International Conference on Intelligent Transport Systems  | Singapore              |
| Sep 4-6, 02          | 2002 International Conference on Simulation of Semiconductor Processes and Devices (SISPAD2002)               | Kobe, Japan            |
| Sep 8-13, 02         | 8 <sup>th</sup> International Conference on Quasicrystals (ICQ8)  | Bangalore, India       |
| Sep 10-12, 02        | 9th IEEE International Conference on Mechatronics and Machine Vision in Practice 2002                         | Chiang Mai, Thailand   |
| Sep 10-14, 02        | The International Conference of Polycrystalline Semiconductors 2002   | Nara, Japan            |
| Sep 11-14, 02        | 8th International Workshop on Shock Tube Technology   | Bangalore, India       |

| Date                 | Name  | Place                  |
|----------------------|---|------------------------|
| Sep 16-18, 02        | The 10 <sup>th</sup> Japan-U.S. Conference on Composite Materials   | California, USA        |
| Sep 16-19, 02        | 4 <sup>th</sup> International Symposium on Humidity and Moisture (ISHM 2002)  | Taipei, Taiwan         |
| Sep 17-20, 02        | 2002 International Conference on Solid State Device and Materials (SSDM2002)  | Nagoya, Japan          |
| Sep 17-20, 02        | The Third Asian Pacific Laser Symposium (APSL2002)  | Osaka, Japan           |
| Sep 18-20, 02        | 11 <sup>th</sup> International Plastic Optical Fibers Conference 2002 (POF 2002)  | Tokyo, Japan           |
| Sep 22-25, 02        | 6 <sup>th</sup> International Symposium on Optical Storage (ISOS2002)   | Wukan, China           |
| <b>Sep 23-27, 02</b> | <b>The 10<sup>th</sup> International Conference on Environmental Ergonomics (ICEE 2002)</b>                                   | <b>Fukuoka, Japan</b>  |
| Sep 25-26, 02        | Research and Development in IT 2002 (CoRDIT 2002)   | Kelana Jaya, Malaysia  |
| Sep 25-27, 02        | Minerals Engineering 2002   | Perth, Australia       |
| Sep 25-27, 02        | The 4th Asian Control Conference  | Singapore              |
| Sep 25-27, 02        | 8th International Conference on Virtual Systems and Multimedia (VSMM 2002)  | Gyeongju, Korea        |
| Sep 25-28, 02        | International Conference on Structural Integrity and Fracture (SIF 2002)  | Perth, Australia       |
| Sep 29-Oct 3, 02     | 6 <sup>th</sup> International Conference on Mechatronics Technology   | Kitakyushu, Japan      |
| Sep 30-Oct 4, 02     | 3rd Asia-Pacific Surface Interface Analysis Conference (APSIAC'02)  | Tokyo, Japan           |
| Oct 6-10, 02         | IEEE/PES Transmission and Distribution Conference and Exhibition 2002: Asia Pacific   | Yokohama, Japan        |
| <b>Oct 9-11, 02</b>  | <b>JSASS 16th International Sessions in 40th Aircraft Symposium</b>   | <b>Yokohama, Japan</b> |
| Oct 10-11, 02        | 24th International Symposium on Dry Process (DPS2002)   | Tokyo, Japan           |
| Oct 14-18, 02        | Photonics Asia  | Shanghai, China        |
| Oct 14-18, 02        | 2nd Asia-Pacific Optical and Wireless Communications (APOC2002)   | Shanghai, China        |
| Oct 15-17, 02        | 11th International Symposium on Semiconductor Manufacturing (ISSM2002)  | Tokyo, Japan           |
| Oct 15-18, 02        | The 10 <sup>th</sup> JSME Materials and Processing Conference (M&P 2002)  | Honolulu, Hawaii       |
| Oct 20-23, 02        | IEEE International Symposium on Micromechatronics and Human Science (MHS 2002)  | Nagoya, Japan          |
| Oct 21-23, 02        | Asian Symposium on Biomedical Optics and Photomedicine  | Sapporo, Japan         |
| Oct 21-24, 02        | AsiaTrib 2002 International Conference  | Cheju, Korea           |
| Oct 21-25, 02        | The 4 <sup>th</sup> International Symposium on Control of Semiconductor Interfaces (ISCSI-4)                                  | Karuizawa, Japan       |
| Oct 23-25, 02        | 7 <sup>th</sup> IEEE/IEICE International Symposium on High Assurance Systems Engineering (HASE 2002)                          | Tokyo, Japan           |
| Oct 23-27, 02        | Third International Asia-Pacific Symposium on Remote Sensing of the Atmosphere, Ocean, Environment, and Space                 | Hangzhou, China        |
| Oct 27-Nov 1, 02     | The Seventh International Conference on Technology of Plasticity  | Yokohama, Japan        |
| Oct 28-31, 02        | The 17th IEEE Region 10 International Conference on Computers, Communications, Control and Power Engineering (IEEE TENCON'02) | Beijing, China         |
| Oct 28-Nov 2, 02     | International Symposium on Bio-Trace Elements 2002 (BITREL2002)   | Yamanashi, Japan       |
| Oct 29-31, 02        | Small Engine Technology Conference (SETC)   | Kyoto, Japan           |
| Oct 29-31, 02        | WHO, EMF Biological Effects and Standards Harmonization Meeting   | China                  |
| Oct 30-Nov 1, 02     | 3 <sup>rd</sup> International Conference on Optics-photonics Design & Fabrication (ODF 2002)                                  | Tokyo, Japan           |
| Nov 3-7, 02          | The Sixth International Symposium on Micro Total Analysis System  | Nara, Japan            |
| Nov 4-7, 02          | Pacific Rim Radio Frequency Radiation Conference  | Phuket, Thailand       |
| Nov 5-8, 02          | International Topical Meeting on Microwave Photonics (MWP 2002)   | Hyogo, Japan           |
| Nov 6-8, 02          | International Symposium on Cyber Worlds: Theories and Practices   | Tokyo, Japan           |
| Nov 6-8, 02          | 2002 International Microprocesses and Nano-Technology Conference (MNC2002)  | Tokyo, Japan           |
| Nov 9-22, 02         | 2002 Asia-Pacific Microwave Conference (APMC2002)   | Kyoto, Japan           |

| Date                 | Name  | Place                      |
|----------------------|---|----------------------------|
| Nov 11-13, 02        | Heli Japan 2002 AHS International Meeting on Advanced Rotorcraft Technology and Life Saving Activities                  | Utsunomiya, Japan          |
| Nov 12-14, 02        | The 3 <sup>rd</sup> International Symposium on Advanced Science Research: Advances in the Physics of f-electron Systems | Ibaraki, Japan             |
| Nov 12-15, 02        | International Symposium on Alcohol Fuels (ISAF XIV)   | Phuket, Thailand           |
| Nov 17-20, 02        | The 8 <sup>th</sup> Pacific Rim Biotechnology Conference  | Auckland, New Zealand      |
| <b>Nov 18-22, 02</b> | <b>9th International Conference on Neural Information Processing (ICONIP02)</b>   | <b>Singapore</b>           |
| Nov 18-22, 02        | 4th Asia-Pacific Conference on Simulated Evolution and Learning   | Singapore                  |
| Nov 18-22, 02        | International Conference on Fuzzy Systems and Knowledge Discovery   | Singapore                  |
| Nov 19-22, 02        | 2002 Asia-Pacific Microwave Conference (APMC 2002)  | Kyoto, Japan               |
| Nov 24-28, 02        | First International Conference on Information Technology Applications (ICITA 2002)                                      | Bathurst, Australia        |
| Nov 26-28, 02        | 2002 Interim International Symposium on Antennas and Propagation (ISAP i-02)  | Yokosuka, Japan            |
| Nov 27-29, 02        | Seventh International Conference on Manufacturing   | Bangkok, Thailand          |
| <b>Dec 2-3, 02</b>   | <b>Third Australian Conference on Laser Diagnostics in Fluid Mechanics and Combustion</b>                               | <b>Brisbane, Australia</b> |
| Dec 2-5, 02          | IUPAC Polymer Conference on the Mission and Challenges of Polymer Science and Technology (IUPAC-PC 2002)                | Kyoto, Japan               |
| Dec 2-6, 02          | The Sixth Asia-Pacific Symposium on Engineering Plasticity and its Applications   | Sydney, Australia          |
| Dec 2-6, 02          | The 15th Australian Joint Conference on Artificial Intelligence (AI'02)   | Canberra, Australia        |
| Dec 4-7, 02          | 5 <sup>th</sup> Asia-Pacific Conference on Medical and Biological Engineering   | Singapore                  |
| <b>Dec 5-6, 02</b>   | <b>Future of Artificial Intelligence</b>  | <b>Maebashi, Japan</b>     |
| <b>Dec 9-12, 02</b>  | <b>The 2002 IEEE International Conference on Data Mining (ICDM'02)</b>  | <b>Maebashi, Japan</b>     |
| Dec 10-12, 02        | The 5th International Conference on Nano-Molecular Electronics (ICNME2002)  | Kobe, Japan                |
| Dec 11-13, 02        | IAPR Workshop on Machine Vision Applications (MVA2002)  | Nara, Japan                |
| Dec 13-15, 02        | US-Japan Workshop on Future AI  | Isuzu, Japan               |
| Dec 15-18, 02        | 8th Asian Conference on Solid State Ionic's   | Langkawi, Malaysia         |
| Dec 15-18, 02        | Intelligent Systems and Applications ISA 2002   | Shanghai, China            |
| Dec 16-19, 02        | 6th International Conference/Exhibition on High Performance Computing (HPC-Asia 2002)                                   | Bangalore, India           |
| Jan 13-15, 03        | 1st International Symposium on Information Technology in Engineering  | Sydney, Australia          |
| <b>Jan 21-24, 03</b> | <b>Topical Workshop on Heterostructure Microelectronics (TWHM'03)</b>   | <b>Okinawa, Japan</b>      |
| Apr 6-10, 03         | International Conference on Acoustics, Speech and Signal Processing (ICASSP)  | Hong Kong, China           |
| <b>May 12-16, 03</b> | <b>Shape Modeling International 2003 (SMI 2003)</b>   | <b>Seoul, Korea</b>        |
| May 19-22, 03        | SAE "Spring" Fuels & Lubricants Meeting   | Yokohama, Japan            |
| <b>May 19-23, 03</b> | <b>The 4th International Conference on Intelligent Processing and Manufacturing of Materials (IPMM'03)</b>              | <b>Sendai, Japan</b>       |
| May 28-30, 03        | Third International Conference on Fatigue of Composites (ICFC 3)  | Kyoto, Japan               |
| Jun 25-27, 03        | Third International Symposium on Turbulence and Shear Flow Phenomena  | Sendai, Japan              |
| Jul 7-11, 03         | 5 <sup>th</sup> International Congress on Industrial and Applied Mathematics  | Sydney, Australia          |
| Jul 20-25, 03        | The 24th International Symposium on Shock Waves   | Beijing, China             |

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